Computer failures

- a long catalog of computer failures (textbook ch. 8)
    - problems for individuals
    - system failures – mission-critical, affecting large groups of people (non-life threatening)
    - Safety-critical applications
        - medical
            - the Therac 25 incident (in the previous class)
            - the retrofitted stereotactic surgery 2010 over-radiation incident
        - air traffic control
- attempt to remedy?

Some spectacular failures

- Denver (also HK) airport management
- Complexity of mission-critical and safety-critical systems
  - Use specialized devices (scanners, displays, data entry)
  - Involve human operators

Retrofitted stereotactic surgery

- SRS – Precise non-invasive surgery by radiation (CyberKnife)
- A „new" machine or retro-fit to an existing linear accelerator radiation machine
- Evanston incident
  - 3 over-radiated patients
  - investigation

Investigation

- Radiation much stronger that in the traditional radiation treatment
- The cone and the „jaws"
- If the spread of the „jaws" that generate the beam exceeds the diameter of the cone, radiation leaks
- In the retrofitted radiation machine a tray hides the jaws, operator cannot see the spread

- Three computer systems are involved for
  - Treatment plan
  - Verification of the plan agaiunst the prescription
  - Control of the linear accelerator
- This complexity is due retrofitting
- Complexity:
  - Software updates need to be in sync
    - Between themselves
    - With the devices (cones) being updated

- Similar previous incidents with Varian equipment in Toulouse, France, in 2007: 145 patients affected (smaller doses)
- No system for reporting such acidents so that other hospitals would learn
- Easy FDA approval of retrofitted SRS devices as extensions of existing technology

Commonalities of failures

- Reuse of software from earlier systems: Therac25, Ariane
- The human-system interface: people that operate the system make mistakes
- How can that be remedied?
- Testing
- **Better training** will go a long way towards remedying at least some of the failures